

PART I

Constructing a Human Pedigree

Pre-Lab Discussion

Human traits are often difficult to study for several reasons. Unlike some organisms, which produce large numbers of offspring very quickly, humans reproduce slowly and produce few offspring at one time. Thus human traits must be studied through population sampling and pedigree analysis. A *pedigree* is a diagram that shows the phenotype of a particular genetic trait in a family from one generation to the next. Genotypes for individuals in a pedigree often can be determined with an understanding of inheritance and probability.

In this investigation, you will use both population sampling and pedigree analysis to observe human traits.

Problem

How can pedigree analysis help in the study of human traits?

Materials (per student)

No special materials are needed.

Procedure

Part A. Interpreting a Pedigree Chart (EAR LOBES)

- Figure 1 is a pedigree, or a diagram of a family's pattern of inheritance for a specific trait.

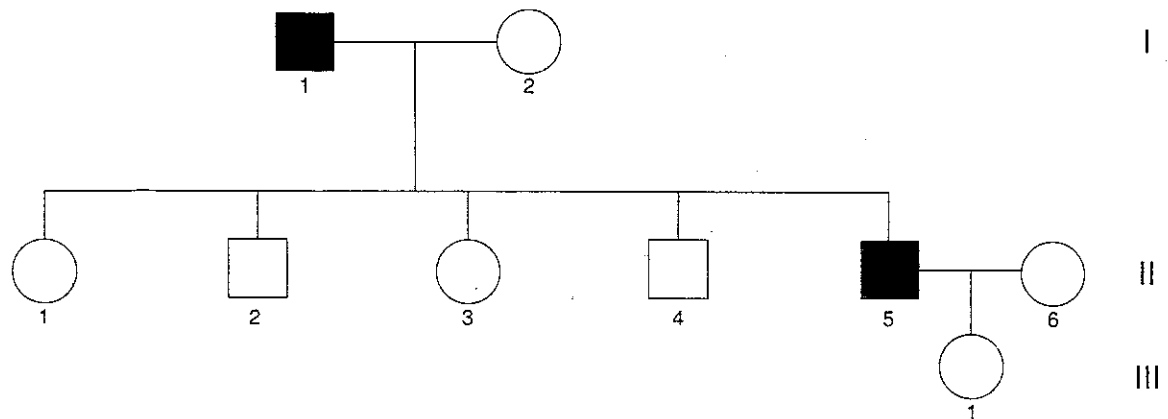


Figure 1

2. Notice that in a pedigree, each person is represented by an Arabic number and each generation is represented by a Roman numeral. In this way, each person can be identified by a generation numeral and an individual number. Males are represented by squares and females by circles. Unshaded symbols (squares or circles) indicate people who are homozygous or heterozygous for the dominant trait. Shaded symbols indicate people who are homozygous for the recessive trait.
3. In Figure 1, I-1 and I-2 are the parents. The horizontal line that connects them is called a marriage line. The vertical line that extends down from the marriage line connects the children to the parents. Children are listed in order of their births from left to right. In other words, the oldest child is always placed on the extreme left. In this pedigree, persons II-1, II-2, II-3, II-4, and II-5 are the children of persons I-1 and I-2.
4. The trait being analyzed in Figure 1 is ear-lobe shape. There are two general ear-lobe shapes, free lobes and attached lobes. See Figure 2. The gene responsible for free ear lobes, represented by the capital letter E, is dominant over the gene for attached ear lobes, represented by the lowercase letter e. People with attached ear lobes are homozygous for the recessive trait and are represented as ee. In Figure 1, I-1 and II-5 are homozygous recessive (ee) and have attached ear lobes. The people represented by the unshaded symbols have two possible genotypes: EE or Ee.

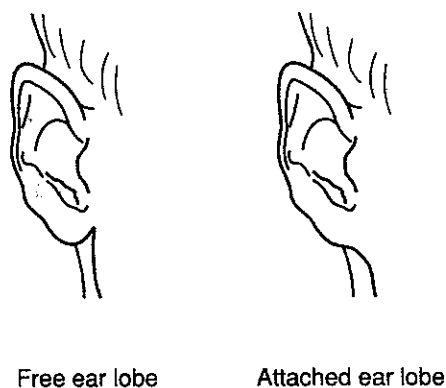


Figure 2

5. Use Figure 1 to complete questions 1 through 8 in Observations.

Part B. Constructing a Family Pedigree

1. In the space provided in Observations, draw the outline of a pedigree of your family or a family who lives near you. In the pedigree, include any grandparents, aunts, uncles, cousins, nieces, or nephews that live nearby. Number the generations and individuals.
2. The ability of a person to roll his or her tongue is the result of the dominant allele R. People who cannot roll their tongues have the genotype rr. People who can roll their tongues have the genotype RR or Rr. If you are developing a pedigree for your own family, determine if you can roll your tongue. See Figure 3.



Tongue roller



Non-tongue roller

Figure 3

3. If you cannot roll your tongue, enter the genotype rr in the space below your symbol on the pedigree.
4. If you can roll your tongue, enter the genotype $R_$ for the presence of the dominant gene in the space below your symbol on the pedigree.
5. If you are constructing a pedigree for your own family, survey additional members of your family for their ability to roll their tongue. If you are constructing a pedigree for another family, survey as many members of that family as possible.
6. Record the results of family members you tested in your pedigree.

Observations (USE FIGURE 1 PEDIGREE, PAGE 151) * REFERS TO EARLOBES

1. What is the genotype of I-2? Explain your answer. _____

2. What are the genotypes of II-1, II-2, II-3, and II-4? Explain your answer.

3. What are the possible genotypes for II-6? Explain your answer. _____

4. If II-6 is EE, what is the genotype of her child with II-5? _____

5. What sex is the oldest child in generation II? _____

6. Who is the youngest child in generation II? _____

7. Who is the daughter-in-law in this family? _____

8. How many generations are represented in this pedigree? _____

Use this space to construct the pedigree for the family you have chosen to study. Correctly number each generation and person. Shade in the symbols for those people who are homozygous recessive. Below the symbol for each person, write as much of the person's genotype as possible. (USE FAMILY HISTORY ON PAGE 156)

Analysis and Conclusions

1. Would you expect the other students in your class to have tongue-rolling pedigrees that are identical to yours? Explain your answer. _____

2. Explain why you are not always able to determine the exact genotype for a trait of a person when you construct a pedigree. _____

3. If two parents are unable to roll their tongues, is it likely that they will have children who will be able to roll their tongues? Explain your answer. _____

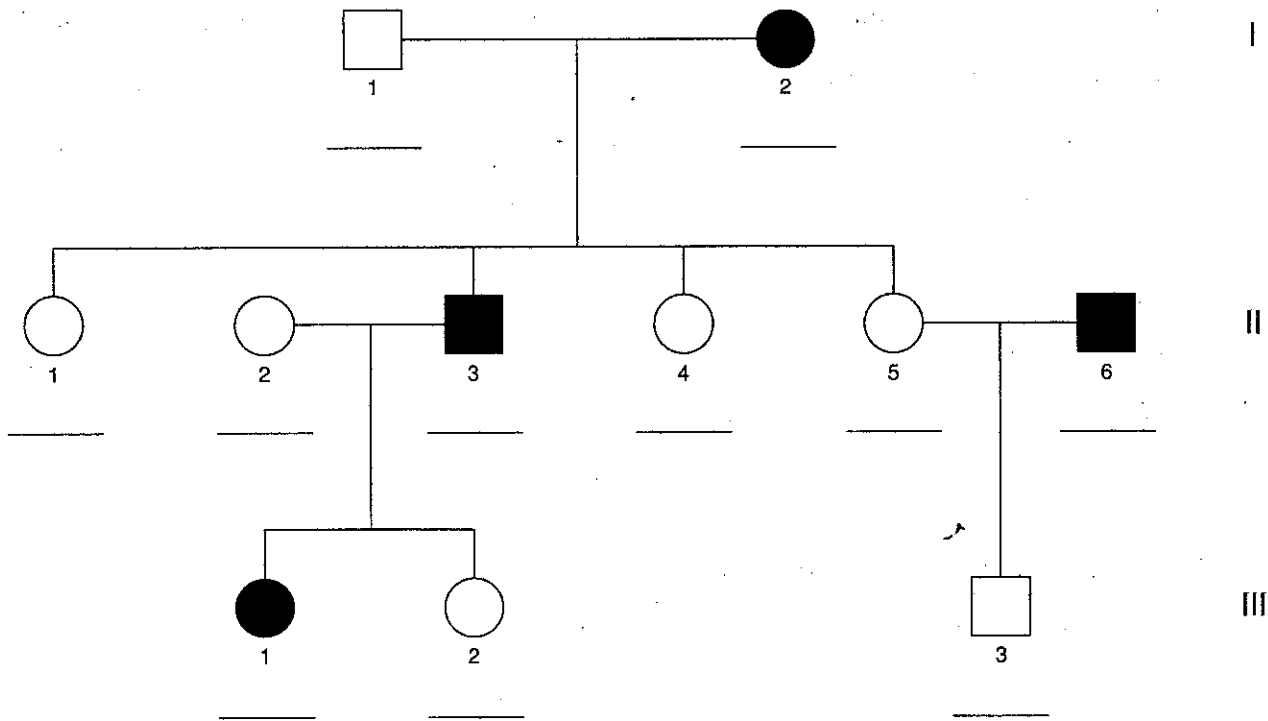
Critical Thinking and Application

1. Can the actual traits of an offspring be determined by knowing the traits of the parents? Explain your answer. _____

2. A woman received the genes aBcD from her mother and AbCd from her father. Which of the following gene combinations could be present in her gametes: ABCD, abcd, ABCDD, aBccD, ABcd, AaBb? Explain your answer. _____

3. If a man who has long eyelashes (LL) marries a woman who has long eyelashes (Ll), what are the possible genotypes and phenotypes of their children? _____

4. Complete the pedigree in the figure below. In the spaces below each symbol, write as much of the genotype of each individual as can be determined from the information provided. Assume the shaded symbols represent the homozygous recessive genotype rr .



FAMILY HISTORY FOR PEDIGREE (pg 154)

GRANDPARENTS

Gloria (rr) marries Peter (Rr)

PARENTS

- Donna (roller) marries Charlie (Rr) →

- Isabelle (non roller)

- Don (Rr) marries Penelope (non) →

- Debbie (roller)

- Anthony (non) marries Carol (non) →

GRANDCHILDREN

Laura (roller), Steven (non-roller), Marc (roller)

Rose (roller), Patrice (roller)

Anthony Jr. (??), Denise (??)

PART II

CHAPTER 11

*Human Heredity***LABORATORY WORKSHEET****OBSERVING HUMAN TRAITS****BACKGROUND INFORMATION**

Humans display a variety of traits that are controlled by a number of different genes. Some human traits are determined by two alleles—one recessive and one dominant. There may be three or more alleles that determine other traits. Still other traits are determined by complex interactions among several genes and environmental factors. In this investigation, you will examine some easily observable traits in your classmates that are determined by the expression of dominant and recessive alleles.

PROBLEM

What are some patterns of human heredity?

MATERIALS (*per student*)

sheet of paper	pencil	mirror
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PROCEDURE 

1. Enter your observations in the data table on the next page.
2. In the column labeled Trait, circle your phenotype for each trait listed. A description of the dominant allele for each trait follows.
 - Tongue rolling (R) is the ability to roll the tongue up at the edges.
 - Widow's peak (W) is a hairline that forms a V in the center of the forehead.
 - Free earlobes (F) are those that hang below the point of attachment to the head.
 - Dimples (D) are indentations on the cheeks.
 - Freckles (F) are brownish spots on the skin.
3. Transfer the data from your data table onto the chalkboard, where your teacher has constructed a chart to collect class data.
4. After your classmates have recorded their data on the chalkboard, record the information in the appropriate place in your data table.
5. To determine the percentage of students demonstrating each trait, divide the number of students who have the trait by the total number of students in the class and then multiply this number by 100. Record the data in the appropriate place in your data table.

OBSERVATIONS

Data Table

Trait		Number of Students Demonstrating Dominant Phenotype	Number of Students Demonstrating Recessive Phenotype	Percentage Demonstrating Dominant Phenotype	Percentage Demonstrating Recessive Phenotype
Dominant	Recessive				
Tongue roller (R)	Non roller (r)				
Widow's peak (W)	Straight hairline (w)				
Free earlobes (E)	Attached earlobes (e)				
Dimples (D)	No dimples (d)				
Freckles (F)	No freckles (f)				

1. For each trait, which occurs more frequently: the dominant or recessive allele?

2. Which trait is the most common in your class? The least common?

3. What is the ratio of the percentages for each of the traits?

ANALYSIS AND CONCLUSIONS

1. Do dominant traits occur more often than recessive traits? Explain your answer.

2. What would happen to your results if you were to perform this investigation with five other classes and recorded their data?

CRITICAL THINKING AND APPLICATION

1. Use height as an example of a hereditary trait to explain how human heredity is different from heredity in peas.
